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ADVICE TO FOREST PLANTERS IN THE PLAINS REGION

SEWARD D. SMITH

FARMERS' BULLETIN 888

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Forest Service

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Washington, D. C. October, 1917

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WASHINGTON : GOVERNMENT PRINTING OFFICE : 1917

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ADVICE about tree planting to provide a windbreak and a supply of firewood, fence posts, and wood for repairs should be especially valuable to the settler in the Plains region.

This bulletin gives advice that will enable him to select the species of trees that will bring the most profitable returns without overburdening him with care.

Following the description of each species of tree adapted to the region, the points to be avoided in connection with its planting are summarized in a few concise " dont's."

Information and advice also are given regarding time for planting, methods of cultivation, pruning, etc.

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OBJECTS OF PLANTING.

TREES and snrubs about the home and farmstead not only increase the value of the property, but make conditions pleasanter and more healthful. A limited amount of planting may be done, therefore, for comfort alone irrespectice of other return. Where a considerable plantation is contemplated, however, it is essential to know what material may be grown economically and the uses to which it may be put.

On the average farm in the plains region the first effort in planting is to provide a small grove or plantation which will protect the buildings from severe winds and furnish shade for greater comfort of both man and animals. Sometimes when such a windbreak has been established the owner tries to make it furnish a supply of material for use on the farm. This is a mistake, for if a belt of trees is planted primarily as a protection against the wind the pruning and removal of much large material may lessen or even destroy its protective value.

The value of a plantation, other than a windbreak, on the farm lies in its ability to furnish fuel, posts, and a limited amount of lumber and repair material. Within a very few years after planting, the plantation will need to be pruned and the pruning will furnish considerable fuel, depending upon the size of the plot. If good care is given the trees, they will develop rapidly, and some thinning will have to be done to prevent harmful crowding. The material thus removed will contribute materially to the upkeep of the farm by furnishing posts and stakes. When the plantation is still older, more valuable material may be harvested. Small tim-

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bers for building construction, poles for implements, also tool handles, neck yokes, eveners, whiffletrees, and, in favorable situations, a limited amount of lumber is provided at home as needed.

THE REGION.

The species listed in this bulletin are in general suitable for the plains region in the eastern parts of Montana, Wyoming, Colorado, and New Mexico, the western portions of the Dakotas, Nebraska, Kansas, and Oklahoma, and the northern part of Texas. The land in this region is comparatively level and is cut by occasional streams or stream beds marked by limited tree growth, which decreases as one goes westward toward the head of the streams until the mountains are reached. The altitude varies from about 1,500 feet in the east to 5,500 feet in the west. The soil is comparatively uniform and for the most part has good depth and fertility, so that it lends itself to tree culture if proper care is given.

There is, of course, a difference in the rate of tree growth at the extreme limits of the region, but this is due more to difference in the length of growing season than to conditions of soil and moisture. Aridity and temperature are the main factors which determine the success or failure of plantations in the plains regions. Any species which will endure the extremes of these occurring in any part of the plains may be recommended for general planting in the region. For convenience in listing the species suited to each portion the region is divided into the northern and southern parts by the fortieth parallel, which forms the boundary line between Kansas and Nebraska.

CHOICE OF SPECIES.

Throughout the plains region there is a marked scarcity of timber which will produce even a fair grade of lumber, and this fact should be taken into account when species are selected for planting. When a large plantation is established, care should be taken to put out such trees as will give the maximum amount of body material and to arrange them so as to derive the greatest benefit.

In windbreak planting the best results usually are secured when the shortest trees are placed on the side facing the wind, so that a sloping face is presented and the air currents are deflected upward. These short trees should have low-branching habits and dense foliage, in order that they may offer as much hindrance to the passage of air currents close to the ground as is possible. The Russian olive is probably the best for this. Not infrequently, when complaints are made of the reputed ineffectiveness of windbreaks, it develops upon examination that the planter has either used unsuitable species and given them poor care or has failed to establish belts of sufficient width.

It should be understood that the species herein recommended for the plains region are not the only ones which may be grown. They are selected because, under the normal conditions in the plains, they will make reasonable growth without a burdensome amount of care. Of course, a certain amount of moisture and cultivation is necessary for any species, and if it is not given failure will result.

SPECIES RECOMMENDED FOR PLANTING.

NORTHERN REGION.

The northern half of the plains region, which includes the eastern portions of Montana, Wyoming, and Colorado, and the western portions of the Dakotas and Nebraska, is characterized by lower temperatures, heavier precipitation, and a shorter growing season than the southern half. The species recommended for it are as follows:

HARDWOODS.

Hackberry (*Celtis occidentalis* Linn.).—The hackberry is one of the hardiest of the native trees in the plains region, and often thrives under severe conditions. It deserves much wider use in plantations than it now gets. Hackberry associates readily with elm and ash and is recommended for planting in mixture with either. When it is planted alone, the leaves, which are not so tough as those of the elm, suffer considerably from whipping in the wind.

In form and general appearance it resembles the common elm, but is much more hardy and suffers less from insects, except in the Southwest. By nature, the hackberry develops into good form, which makes it highly desirable either for a timber tree or for use in the yard or street.

It seeds very sparingly, so that planters desiring to try it will do well to purchase thrifty stock from reliable nurserymen. It is adapted to a wide range of soils, but makes its best development in moderately moist, loamy, or sandy soils. It should not be planted in alkali soils.

The wood is harder than cottonwood and makes good poles and small construction timbers, but should not be used in contact with the soil without preservative treatment.

Honey locust (*Gleditsia triacanthos* Linn.).—Since the introduction of honey locust from the northeastern States into the plains region of the West it has made a good record as a hardy, rapid-growing, general-purpose tree for wood-lot, street, or yard planting. It is drought resistant and is noted for its endurance of extremes of temperature, which makes it particularly valuable for planting in the northern region. It is suited to a variety of soils and may be planted very successfully on the dry upland areas.

Some objection is made to its heavy thorns, but these may be pruned off easily. It may be readily pruned into a hedge, in which case the thorns may be desirable. Some nurserymen are now supplying a thornless variety which is declared to be equally hardy.

The wood is more valuable for posts and fuel than for larger material. Without preservative treatment it is recommended for posts only in the drier soils. With cultivation it endures close crowding until the crowns shade the ground, and it will produce fully as much material as the elm or hackberry.

White elm (*Ulmus americana* Linn.).—The elm is very popular, and deservedly so, since it is a native tree and does well under cultivation. It thrives in a heavy soil but can not be recommended strongly for sandy areas. In many sections of the plains it is making good growth both on the uplands and on the river bottoms.

The tree is subject to occasional defoliation by insects. These, however, are easily controlled by means of insecticides, and in some cases the trees make good the damage unaided, all of which recommends it for general planting. This species usually makes its best development when planted alone in a protected place but also does well if planted in mixture, since its rapidity of growth soon enables it to overtop the others. For windbreaks it is recommended strongly because of its toughness, which prevents its being broken readily in storms, and because its foliage is exceedingly resistant to the damaging effects of wind.

In a large plantation one can not afford to overlook this tree, since its long life and freedom from disease combine to furnish a continual supply of useful material for the farm. It is better suited to making small timbers and tool handles than posts. Even with preservative treatment it is not the most desirable for fence posts.

Recent importations of foreign trees include the Chinese elm,[1] which is very hardy and a much more rapid grower than the common elm, but as yet the commercial nurseries are not ready to furnish this species.

Don't use the American elm for posts if you can grow honey locust.

Don't attempt to prune it into a hedge.

Cottonwood (*Populus deltoides* Marsh).—Of all the poplars the cottonwood undoubtedly is the most common, and it grows naturally in moist situations on the plains. It can not be recommended for upland planting; but on sites which are favored with a small amount of moisture, even if at considerable depth, it will justify planting.

It makes its best development when not closely crowded, but produces the maximum amount of material when set out in plantations, either alone or in mixture with other species.

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[1] *Ulmus pumila* Linn.

All the poplars are relatively short-lived and often in a short time their appearance is marred by the persistence of numerous dead branches. For this reason alone the planter should go slow in using cottonwood for street or yard planting. There is considerable prejudice against cottonwood trees because of the winged seed or so-called "cotton," which is scattered by the wind in the spring and early summer when the seed is ripe. Only the pistillate (female) plants produce this cotton, which has made it possible for some nurserymen to charge fabulous prices for staminate (male) plants and advertise them as "cottonless" cottonwood. The tree is raised easily from cuttings, and when the scion is taken from the staminate trees (which do not bear seed) the trouble from the flying seed will be avoided. Not infrequently it is cheaper and more satisfactory to dig seedlings from the river bank or to make cuttings from the staminate trees found there than to purchase them in the open market.

Cottonwood, without doubt, is the most rapid-growing tree in the region; and if the planter does not care to wait for material from the more desirable trees, such as honey locust or hackberry, cottonwood should be used. In regions where hailstorms are frequent and severe considerable damage is often done to the tender bark of the younger trees.

For the rapid production of fuel this tree can not be excelled. It also furnishes a fair grade of building material, but the lumber will warp if exposed to the weather. The most common use of cottonwood is for bridge planking and stall partitions. It is of little value for posts unless treated with preservative.

Don't plant cottonwood on high, dry land.

Don't plant cottonwood for a long-lived tree.

Don't plant pistillate (female) plants if you object to the "cotton."

Don't use cottonwood in the soil without preservative.

Don't plant cottonwood singly or in the open if you want quick returns.

Narrow-leaf cottonwood (*Populus angustifolia* James).—The most widely known of the poplars, except the common cottonwood, cultivated in the plains region is the narrow-leaf cottonwood. It is a native of the plains from Canada to Colorada and is found most plentifully along the stream banks and in moist soils, where it attains its best development. Popularly speaking, it is very little different from the common cottonwood, with which it frequently associates. It does not grow to so large a size as the common cottonwood.

The wood is soft and suitable mostly for planking and rough indoor construction work.

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White poplar (*Populus alba* Linn.).—The white poplar (the silver-leaf poplar) was introduced into this country from Europe, but has become naturalized through cultivation. It is a rapid grower and rather hardy, but is recommended for ornamental or windbreak planting only. It will not endure the rough usage sometimes given the common cottonwood. The tree always is noticeable because of the white, velvety appearance of the leaves, which are conspicuous whenever disturbed by the wind.

It has no value for lumber or posts.

White willow (*Salix fluviatilis* Nutt.).—The white willow, sometimes called the long-leaf willow, is the most widely distributed of the trees of this genus. Like the cottonwoods, to which it is closely related, it makes its best development in or near stream beds where the supply of water is constant and not very deep. It is used both in windbreaks and for the production of post material. Only in cases where it will receive the best of care is it recommended for upland planting. In the plains region this species seems very hardy within its own range.

It is used more for posts than for other purposes because of its ability to resist decay for a relatively long period. Preservative treatment undoubtedly would lengthen its life in the soil. It is a very rapid grower, but must be planted rather close to produce suitable material in the shortest time.

Don't plant white willow in a dry situation.

Don't fail to plant the trees close together.

Diamond willow (*Salix vestita* Pursh.).—Diamond willow, which partakes more of the nature of a large shrub than a tree, is limited to the northern portion of the region. It is a native of Montana and is very hardy. It has the reputation of making excellent post material, even though rather small. This is one of the numerous varieties of willows extensively advertised by nurserymen as admirably adapted to this region.

Russian olive (*Elaeagnus angustifolia* Linn.).—The Russian olive rarely exceeds 20 feet in height, but despite its shrubby appearance it is one of the hardiest and best trees for both windbreak and ornamental planting. When planted alone, it rapidly develops a dense hedge, and, if not crowded, will spread out close to the ground, a very desirable trait in a hedge plant or windbreak. It is not fastidious in its choice of sites, but its growth is best in soil which is not too moist. It is always helped by cultivation. It is very hardy throughout the plains regions and deserves much more attention than has been given it. Its unique silver foliage adds wonderfully to any situation in which it is planted. It is not recommended for timber production, but will produce a limited amount of fuel.

Don't plant the Russian olive for timber.

Don't plant it on low ground.

Buffalo berry (*Shepherdia argentea* Nutt.).—The buffalo berry is fully as hardy and as beautiful in appearance as the Russian olive. It is, properly speaking, a shrub; but for hedges, windbreaks, and ornamental planting it can not be surpassed. The red and yellow fruit and silvery foliage make a very pleasing combination either when the trees are planted alone or in a compact block. This species is a native of Montana and may be depended upon to give satisfactory results in all the northern portion of the plains. In some sections the fruit is used for domestic purposes.

Don't try to make the buffalo berry produce posts or lumber.

Don't expect it to make a large shade tree.

Siberian pea tree (*Caragana arborescens* Linn.).—Although essentially a shrub, rarely over 15 feet in height, the Siberian pea tree has considerable to recommend it over some of the more common trees. It is very hardy and lends itself readily to planting as a hedge for ornament or windbreak. On the lawn it develops rapidly with little care and makes a very pleasing appearance by reason of its yellow flowers. It is not suited to locations where no water is available.

Don't plant this tree for posts or timber.

CONIFERS.

It is more difficult to obtain successful species for the plains among those trees which hold their leaves over the winter, or evergreens, as they are sometimes called, than among hardwoods. There is a prejudice against conifers, and many people who desire to plant them hesitate because of reputed losses. The roots are very delicate, and exposing them to the sun or wind for even a few minutes will kill the tree, whereas the roots of hardwoods are often exposed for a much longer time without great loss. When people learn to care for the young trees and plant them properly, more conifers will be used. As a rule they are slower growing than hardwoods, but eventually make the more serviceable trees, not only because they are drought resistant when thoroughly established, but because they carry their dark green foliage all the year and give a cheery atmosphere to the landscape during the winter months.

Jack pine (*Pinus divaricata* DuMont de Cours).—Until about 10 years ago very little was known of jack pine, which is native to the sand plains of the Lake States and adjoining territory. It is most at home on these plains, which become very dry, but it will accommodate itself to a great variety of sites except where there is an excess of moisture and the soil is heavy.

Jack pine is being planted extensively in the plains region, and in practically every case it has established an enviable reputation for

hardiness and rapidity of growth even under adverse conditions. Several hundred acres are planted annually to this species by the Federal Government in the sand hills of Nebraska, and good results have already been secured. Jack pine does fully as well upon the uplands and sandy land as upon the more fertile bottoms.

It is essential in every case that the tree be protected from heavy grass and sod during the first three years; after that it will care for itself.

Jack pine is a rapid grower, and although not so valuable as western yellow pine is used extensively for windbreaks, posts, poles, and fuel. It is doubtful whether it will ever produce saw timber of any value.

Don't plant jack pine in low wet ground.

Don't plant jack pine to produce large saw timber.

Western yellow pine (*Pinus ponderosa* Laws).—Western yellow pine may be recommended under much the same conditions as jack pine. During the first few years it grows more slowly than jack pine; but this handicap is soon overcome, and at 10 years of age the yellow pine is farther ahead and the tree is much more symmetrical. In the sand hills of Nebraska, where several hundred acres of this species have been established by the Federal Government, there is an increasing demand for it, and it promises to be the best tree for timber production in the region. It may be used in mixture with other species or as a block of pure yellow pine. If not surrounded, it has a tendency, common to most trees, to branch and become scrubby, thus losing its symmetry and much of the real value as a timber producer, which comes only when it is compelled by crowding to make a height growth proportionate to the diameter.

For general service, where beauty, hardiness, and valuable material are desired, this tree is recommended. Posts, poles, and other construction material may be obtained from the smaller trees. The better specimens will furnish a good grade of lumber. The wood is strong and hard.

The pine tip moth[1] ofttimes works considerable havoc by destroying the terminal buds. Where this insect is not present in large numbers, however, this tree makes very good growth.

Don't plant western yellow pine on steep south slopes.

Don't plant western yellow pine singly or without cultivation.

Don't plant western yellow pine where neighboring pines are infested by the pine tip moth.

Don't plant western yellow pine or western yellow pine seedlings or transplants shipped from an infested region or nursery.

[1] *Evetria bushnelli* Busck.

SOUTHERN REGION.

All the species recommended for the northern portion of the plains region may be planted in the southern portion, which includes southeastern Colorado, western Kansas and Oklahoma, and northern Texas, and on account of the more moderate temperatures it is possible to extend the list. The following additional species are recommended:

HARDWOODS.

Boxelder (*Acer negundo* Linn.).—The boxelder, or ash-leaved maple as it is sometimes called, is the hardiest of the maples and grows rather rapidly; but because of its low, dense branching habit and knotted trunk it is more desirable for windbreaks or plantations than for ornamental use. It does best when planted rather close. It is more adapted to the trying conditions of the plains than the Norway maple,[1] which, although less hardy, is more desirable as a shade tree and is frequently used where a fertile, moist soil is provided.

The boxelder is recommended only for the bottom lands, where there is a heavy soil. It is a mistake to plant it upon uplands and sandy soils.

At its best it is short lived, and the wood has unusually poor value even for fuel. Preference might well be given other species if they can be secured.

Don't plant boxelder north of the Kansas-Nebraska line.

Don't plant it in dry or exposed situations.

Don't plant it on uplands and sandy soil.

Green ash (*Fraxinus lanceolata* Borkh.).—Green ash will endure more severe conditions than the boxelder and is more serviceable in general appearance, rate of growth, and quality of timber. In its native State it is short, with well-rounded head and many crooked branches. It is more desirable for windbreaks or posts and fuel than for ornament unless planted in groups and given considerable care.

During the first year or two the young plants may lose some of their tops through winter killing, but as the trees get older this tendency is overcome. Native-grown trees for planting are preferable to those raised in the more humid regions. The green ash responds quickly to good treatment, and its value as a producer of useful material is largely dependent upon the care given it.

The wood is tough, durable, and straight grained and is considered one of the best of the native woods for fence posts. It is used also for tool handles and in some cases for construction material.

Don't plant green ash on extremely dry sites.

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[1] *Acer platanoides.*

Don't plant it north of the Nebraska-South Dakota line.

Black locust (*Robinia pseudacacia* Linn.).—Were it not for the fact that black locust is often attacked by the locust borer, it doubtless would be planted more generally than any other species in the plains. It makes more than ordinary growth on the uplands and endures the extremes of temperature in the southern plains region to a remarkable degree.

The wood is very durable, even in contact with the soil, and it also possesses great strength and fuel value. The borer[1] attacks trees 2 to 5 inches in diameter, those less than 2 inches being free from injury, while trees 3 to 5 inches suffer most severely. It thrives where there is an abundance of goldenrod, since the adults, or beetles, feed on the pollen of this plant before they are ready to oviposit. The Bureau of Entomology is experimenting with control operations against it on a large scale and will publish the results when these are completed. The scheme followed by some is to establish a plantation every five to eight years, so that the material can be removed before it is large enough for the insects to do much damage.

Don't plant black locust north of the Kansas-Nebraska line.

Don't plant it on pure sand.

Don't plant it where borers are prevalent unless the adoption of remedial measures is contemplated.

CONIFERS.

Red cedar (*Juniperus virginiana* Linn.).—Of all the cultivated varieties of juniper, red cedar probably is the most hardy and satisfactory for this region. Its preference is for heavy or limestone soils and it avoids sandy soils. The great objection to it is that its growth is very slow. This is in part compensated for, however, by the hard, fine-grained wood, which is eagerly sought for fence posts.

In the lawn this tree makes a very pleasing combination with the varying shades of green of other species. It is native to Kansas and Nebraska and gradually is extending itself westward. The red cedar is the longest-lived tree among those suitable for this region, which makes it excellent wherever permanent trees are desired. It gives protection both in summer and winter.

This species should not be planted in the vicinity of an apple orchard. The "cedar apple" fungus, which is one stage of the apple leaf spot, may infect apple trees even at a considerable distance. When planted alone and in much exposed places red cedar should not be pruned.

Don't plant red cedar on pure sand.

[1] *Cyllene robiniæ* Forst.

Don't plant red cedar near an apple orchard.

Don't plant red cedar if you want a quick-growing tree.

Chinese arborvitæ (*Thuya orientalis* Linn.).—Unlike our native American arborvitæ the Chinese arborvitæ thrives on heavy upland or limestone soils. It is not a large tree, but its small size is more than offset by its hardiness and luxuriance of growth. It is admirably adapted to windbreaks and decorative planting about the home, either singly or in mixture, but is not to be relied upon for the production of timber. It is an importation and little is known concerning its behavior in old age, but its hardiness appeals to the home builder in this region.

Don't plant Chinese arborvitæ on sandy areas without heavy soil below.

Don't plant this species if you want timber.

MIXED PLANTATIONS.

Plantations containing two or more species in mixture are so few and of such recent planting that it is not possible to refer to them as examples, but sufficient evidence has been collected to show that under certain conditions it is preferable to plant certain species together. It may be that one species has a very scant foliage and another is needed to make a crown cover sufficiently dense to shade out the grass and weeds after cultivation has been stopped; or it may be advisable to plant a long-lived species with one which comes to early maturity, so that the quick-growing species may furnish material and then have its place filled by the slower-growing species.

If consideration is given to this when the plantation is established, a better class of material will be secured and less care will be required to produce it. It is, of course, much more important if posts and lumber are to be grown than if a windbreak is the primary object. When conifers are used, hardwoods often may be planted with them, thus reducing the initial cost of the plantation.

Below are given a few species which may well be planted together:

Honey locust with hackberry.	Black locust with red cedar.
Honey locust with jack pine.	Green ash with honey locust.
White elm with hackberry.	Cottonwood with green ash.
Black locust with yellow pine.	Yellow pine with jack pine.

For windbreaks any of the following groups may be used, the first-named species being placed on the side from which the prevailing winds come. At least two rows of each species should be used.

Russian olive.	Russian olive.	Green ash.
White elm.	Hackberry.	Honey locust.
Hackberry.	Honey locust.	Cottonwood.
Cottonwood.	Yellow pine.	Red cedar.
Jack pine.	Russian olive.	

ORNAMENTAL PLANTING.

Very frequently a demand exists for trees or shrubs which are adapted primarily to ornamental or decorative planting in lawns, parks, and cemeteries where it is possible to furnish abundant water, cultivation, and some protection in winter. The following are suggested as suitable in this region for such purposes. It should be understood that these species will not thrive unless considerable care and protection are given them.

White birch (*Betula papyrifera* Marsh.).—Characterized by its white bark and rich green, drooping foliage.

Weeping birch (*Betula papyrifera* var. ————?). A variety of white birch, but with smaller leaves and pendulous branches.

Basswood (*Tilia americana* Linn.).—A rapid growing tree with large, rich green leaves. The delicate white flowers are very fragrant.

Soft or silver maple (*Acer saccharinum* Linn.).—Of all the hardwoods planted in our lawns and parks silver maple is probably the most widely used, with the possible exception of white elm. It is, however, not entirely satisfactory. The limbs are very brittle and are often broken off by the wind. It is a rapid grower; but the new growth is sometimes killed back at periods of low temperature, and the dead limbs mar the otherwise pleasing appearance of the tree.

Hardy catalpa (*Catalpa speciosa* Warder).—Hardy catalpa demands rich soil and the best attention; but the wealth of blossoms in July, when most of our other trees are out of flower, compensates to a certain exent for the extra care. It is very sensitive to low temperature. Because if injudicious advertising this species has been introduced into regions where it can never be expected to give satisfaction.

Black walnut (*Juglans nigra* Linn.).—Black walnut is familiar to nearly every one through the edible fruit or nuts. The tree is a rapid grower, but furnishes only a limited amount of shade. The brittle branches are often broken in the wind.

Bur oak (*Quercus macrocarpa* Michx.).—In certain favorable locations on the plains, possessing rich soil and considerable moisture, bur oak may be grown, but it is a slow grower and will develop into scarcely more than a shrub. It will thrive in well-cared-for lawns, but can not be recommended for general plains planting.

Sycamore (*Platanus occidentalis* Linn.).—The plane, or button-ball tree, as it is sometimes called, is conspicuous on account of its green and white mottled bark and the small rounded heads, carrying the seed, which remain on the tree over winter.

Horse chestnut (*Aesculus glabra* Willd.).—The horse chestnut, noticeable by reason of its peculiar leaves and richly colored blossoms, is used where considerable contrast is desired. It is too large a tree for small lawns and sometimes is objected to on account of the fruit and numerous pods which cover the ground in early fall.

Mountain ash (*Sorbus americana* Marsh).—A relatively hardy ornamental tree, with well-developed crown and bright orange-colored berries, which persist until late in the fall.

Barberry (*Berberis thunbergia* D. C.).—A hardy shrub, made noticeable in the summer by its yellow flowers and in the winter by the bright red berries, which are long persistent.

Purple barberry (*Berberis vulgaris atropurpurea* Linn.).—Similar to green barberry, but marked by rich purple leaves.

Douglas fir (sometimes called red fir, red spruce, or Douglas spruce) (*Pseudotauga taxifolia* (Lam.) Britton.).—A rapid-growing conifer, excellent for lawns and for group planting in parks and similar areas. A wide range in colors makes it very popular for landscape work.

Colorado blue spruce (*Picea parryana* Sarg.).—A hardy conifer in a rich, moist soil and very conspicuous for its rich, bluish-green foliage. Grows much more slowly than Douglas fir, but is extensively used where pleasing landscape effects are desired.

White fir (*Abies concolor* Lindl. & Gord.).—A moisture-loving conifer in much the same class as blue spruce, but with a lighter foliage. Needles are long and flattened instead of square and pointed, as with the spruce. The white fir is adapted more to the northern portion of the region.

DETAILS OF PLANTING.

CHOICE OF PLANTING STOCK.

A plantation established with poor stock always is handicapped. The purchase of cheap stock, simply because it is cheap, is poor economy, for often it results in failure.

Fortunately, most of the hardwoods may be grown easily from seed, and the possibility of buying stock which is not true to name or of having it injured in transit avoided. If the farm maintains a garden plot, the hardwood seedlings may be grown there and planted out in the field when one year old. The seed of the desired species may be purchased or collected locally, sown in rows, and handled much the same as vegetable seed. The plants should be watered and cultivated, so that they will become as large as posisble during the season. After the first of September water should be applied only to keep the ground from drying out completely. This is necessary in order to harden the tender wood to withstand frost.

Cuttings may be used successfully for growing the planting stock for such trees as willows and cottonwoods. These cuttings, which are best made in the fall or early winter after the leaves have fallen, should be about 10 inches in length and taken from 1-year-old or 2-year-old twigs of vigorous, healthy trees. Cuttings should be made always with slanting strokes of a very sharp knife, so as to avoid bruising the bark. If trees free from seed, or "bloom," as it is sometimes called, are desired, cuttings should be taken from trees which observation has shown do not produce seed. As soon as the cuttings are made they should be tied in bundles of about 50 and buried in cool, moist, well-drained sand until spring. As soon as possible in the spring, and always before the soil dries out, the cuttings should be set out, with the buds pointing upward, leaving two or three inches above ground. The soil should be pressed firmly about the stems, and if it is not soft it is better to make holes for the cuttings with a round bar or dibble.

Trees grown from large nuts, such as walnut and oak, are best propagated by planting the nut where the mature tree is desired. Unless this is done, the long, heavy taproot, even at the end of the first year, makes transplanting difficult and the loss heavy. Black walnut is best planted in the fall.

Conifers are much more difficult to raise than hardwoods, and unless a large project is undertaken it is inadvisable to attempt to raise them. Thrifty stock may be purchased from reliable nurserymen and in some cases at cost from nurseries maintained by the State. Stock grown as near as possible to the region of planting is always preferable.

If hardwoods are used, 1-year seedlings give best results under normal conditions. Large stock should be avoided. It is more expensive and requires more time and attention to plant. If conifers are used, nothing smaller than 3-year-old transplants should be tried. Transplants are preferable to seedlings because of the larger mass of fibrous roots.

METHODS OF PLANTING.

Planting methods are dependent largely upon the size of the stock and the condition of the site. When stock is received for planting, the first precaution is to see that it has not dried out. The roots never should be exposed to the sun or drying air. The roots of stock that is packed in crates should be moistened thoroughly before the trees are removed. If the trees are extra-large conifers and the roots of each tree are protected with earth bound with a cloth covering, the whole should be planted without removing the wrapper. In any case, all small stock, if it can not be planted at once, should be heeled in in a cool, moist situation. The tops should not be covered.

All grassy, weedy, or heavy land should, if it is practicable, be plowed and harrowed at least 12 months before the trees are planted. Fall plowing is preferable. If manure is to be used, it should be applied at the time of plowing to enable it to decay. If it is placed fresh next to the roots at the time of planting, there is danger of "burning" them. Although plowing is not absolutely necessary, it is productive of good results, and the benefits are several times as great as those secured by caring for the ground after the stock is set out. It is still better to use ground which has been under cultivation for two or three years. Young plants need just as much care as a garden, and their growth will be proportionate to the amount of care they receive.

Planting may be done in either of two ways: By the slit method or by the individual-hole method.

Either of these methods may be worked out in a shallow furrow. It is very desirable on sod ground to plow a furrow if complete

cultivation of the planting area can not be carried out. This will remove the grass cover and will make the work much cheaper. All sod or grass cover should be removed from a space at least 15 inches square before a tree is planted, provided it is not set in a furrow.

SLIT METHOD.

The slit method is the cheapest and in light, sandy soils the best. A spade is used to open a wedge-shaped hole in the ground by moving it forward and backward. Into this opening the tree roots are suspended full length, and the earth is pressed firmly around them by a thrust of the foot which closes the hole.

DEEP-HOLE METHOD.

A hole is dug wide enough and deep enough to accommodate the tree roots without crowding. Care should be exercised in putting the soil back on the roots to see that no large rocks or sods are allowed to fall in, because of the possibility of leaving air spaces, which will cause the plant roots to dry out. Holes never should be dug a long time in advance of planting, unless it be in the fall, on account of the danger of drying out. If there is a hardpan or stratum of soil impervious to water at the bottom, this should be broken up thoroughly with tools or a light charge of dynamite. Unless this is done the tree will not thrive.

TIME OF PLANTING.

Planting should be done in the spring. The best results are secured from the earliest planting. This rule has no exception in the plains region. Fall planting may be advisable in certain cases where it is possible to give each tree individual attention, but in every case where general planting has been done after the growing season has passed failure has resulted. When trees are planted in the spring, they have the advantage of a full summer's growth and the accummulated winter moisture, and the liability of loss from winter heaving caused by alternate freezing and thawing is slight. It is also a decided advantage if the planting can be done on damp, cloudy days, thus affording the tender roots protection from the hot sun and wind.

SPACING.

The amount of cultivation to be given a plantation determines to a certain extent the spacing of the trees. If the plantation is nearly square, room may be made for working a cultivator both ways by setting the trees in the rows the same distance apart as the rows, but

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if a long, narrow windbreak is being developed it is doubtless preferable to have the trees close together in rows that are far enough apart to allow cultivation to be carried on for several years. A spacing of 2 by 8 feet will give the same number of trees per acre as a 4 by 4 spacing, and will provide for a much longer period of cultivation. The aim should be to keep the ground free from weeds. If the trees are not close enough to accomplish this, cultivation must be practiced, and the spacing should provide for sufficient room for a team and tools to pass easily without injuring the bark of the trees or breaking off the limbs. The tendency is to set the trees too close rather than too far apart. In general, the rule is that a wide spacing with frequent cultivation is productive of better results in the arid regions than close spacing and less frequent cultivation. However, on those farms which are favored with river bottom land the trees should be spaced much closer, since the yield will be greater and the trees will be better formed. In plantations closely spaced some of the smaller or stunted specimens may be thinned out and used for fuel or posts if the trees begin to crowd each other too much.

It is much easier to plant trees for protection from the wind or for the production of posts and fuel than to make a combination of the two, because the removal of much material may lessen the value of the windbreak unless it is very large and planned to furnish other products. If it is desired primarily to grow posts or similar material, the lower branches must be pruned off and the worthless trees cut out, which results, of course, in less obstruction to the wind and very little protection from it unless the planted area is of considerable size. If a windbreak is most desired, the trees should be spaced much more closely in the row without so much consideration for size, in order that the branches filling up between the rows may reach the ground, shade out the weeds and grass, and make a dense shelter and an effective hindrance to the wind. A spacing of 2 by 8 feet gives good results in a windbreak, if the trees are arranged alternately in the rows, but for a timber or post plantation most trees may be set 8 by 8 or 10 by 10 feet and cultivated carefully.

TABLE 1.—*Spacing and soils best adapted to each species and products from each kind of wood.*

Species.	Spacing.	Most suitable soil.	Products obtainable in—		
			5 to 10 years.	20 to 25 years.	Over 50 years.
Hardwoods:	*Feet.*				
Honey locust	10 by 10	Heavy loam.....	Small posts. Cordwood.	First and second class posts. Stakes. Cordwood.	
Hackberry..	8 by 8	Light or heavy soils, if not low.	.....do.....	First and second class posts. Cordwood.	Lumber, timbers.
White elm...	8 by 8	Wide range light to heavy. Moderately moist.	.....do.....	.....do.....	Lumber.
Black locust.	8 by 8	Dry upland.....	.....do.....	.....do.....	Posts and timbers if not destroyed by borers.
Green ash...	8 by 8	Moist loam bottom lands.	Cordwood.....	.....do.....	Lumber.
Boxelder....	8 by 8	Bottom lands. Avoid sand or uplands.	Small posts and stakes. Cordwood.	First and second class posts.	Posts.
Cottonwood.	10 by 10	Moist bottom land	Posts. Cordwood.	First and second class posts. Cordwood. Narrow lumber.	Lumber.
Willows.....	8 by 8	Prefers moist loamy soils. Heavy uplands if well cultivated.	Small posts and stakes.	First and second class posts.	
Russian olive	4 by 8	Thrives on dry uplands.	Windbreaks, ornament, and hedges.	Windbreaks, ornament, and hedges.	
Buffalo berry	2 by 8	Moderately dry soils.	Ornament and hedges.	Ornament and hedges.	
Siberian pea tree.	4 by 8	Moist loamy soils..	Hedges, windbreak, and ornament.	Hedges, windbreak, and ornament.	Hedges, windbreak, and ornament.
Conifers:					
Jack pine....	6 by 8	Sandy soils. Avoid heavy and very moist soils.	Windbreaks.....	First and second class posts. Cordwood.	
Yellow pine.	6 by 8	Endures more moisture than jack pine.	.....do.....	.....do.....	Lumber.
Red cedar...	4 by 8	Heavy or limestone soils.	Windbreaks and hedges.	First and second class posts.	First and second class posts.
Chinese arborvitæ.	4 by 8	.....do.....	.....do.....	Hedges and ornament.	Windbreaks.

TABLE 2.—*Number of trees per acre with various spacings.*

Spacing. Feet.	Number of trees.	Spacing. Feet.	Number of trees.
3 by 3	4,840	5 by 8	1,089
3 by 4	3,630	6 by 6	1,210
3 by 5	2,904	6 by 8	907
3 by 6	2,420	6 by 10	726
4 by 4	2,722	8 by 8	680
4 by 5	2,178	8 by 10	544
4 by 6	1,815	8 by 12	453
4 by 8	1,361	10 by 10	435
5 by 5	1,742	10 by 12	363
5 by 6	1,452	10 by 15	290
5 by 7	1,244	15 by 15	193

CULTIVATION.

Cultivation is just as necessary in establishing a successful plantation of trees as in other lines of agriculture, and the results are

proportionate to the amount of labor expended in keeping the soil loose and free from weeds. It is a mistake to suppose that trees can be grown in a weedy or grassy area without some cultivation or protection from the more rapid growing plants. If a quick, healthy growth is desired, there is no more certain way of insuring it than to cultivate. No other factor goes so far toward lessening the loss resulting from insufficient moisture. To be most effective, cultivation should be begun at least one year before the trees are planted.

A large proportion of failures in plantations are caused by the negligence of the planters. Some even go so far as to argue that native trees receive only the care that nature gives, and therefore it is only necessary to plant them and they will care for themselves. No greater mistake can be made. Trees, the same as other plants, need attention if they are to do well; and cultivation, which has for its object the prevention of the growth of weeds and grass and the conservation of moisture, encourages the growth of the tree most effectively.

Cultivation should be shallow. The roots of many trees run close to the surface of the soil, and if these are injured by cultivation the tree may be stunted in its growth.

Cultivation should take place as soon as possible after each rain. This forms a dust mulch, which is the best means of saving the moisture already in the ground.

Cultivation should not be continued after the middle of July. This is to prevent the development or growth of new wood late in the season which may be injured by severe, early frosts. The danger from this source is greater than is realized ordinarily; oftentimes hardy young trees are killed back to the ground following late cultivation and irrigation.

Don't let the weeds get so high that a plow must be used to destroy them. They rob the trees of moisture, and the plow will injure the fine tree roots.

THINNING.

The object of thinning is to rid the stand of those trees which, because of either their unhealthy condition or crowded position, are retarding the growth of the more desirable individuals. The principle is the same as in other crops which are thinned to promote the best development of a portion rather than a poor growth of the entire crop. When trees are young, they are very sensitive to conditions around them, and if they are crowded the tendency is toward a stimulation of growth and an improvement in quality in the thriftier individuals and a failure in the poorer class. This process, which is entirely natural, disposes of a great many of the weaker trees, but if continued too long may stunt some of the best trees. It is at this

stage that thinning becomes a necessity and the weak and deformed individuals are removed.

Need of thinning is indicated when there are many dead or dying trees in the stand, or when the trees are very slender in proportion to their height. A stand in need of thinning often has the crowns of all the trees densely matted or so closely interlocked that growth apparently has ceased. If the condition of the stand is such that the growth will not be lessened, it is more satisfactory to postpone the thinning until there is enough merchantable material to pay for the cost of removing it from the stand. The first thinning will yield fuel and small posts, and if the poorer material is removed each time each subsequent thinning will yield bigger and better material. Care should be be exercised not to remove so much material that the sunlight will induce a sod cover under the trees. The opening in the tops should close in three or four years. The fact should not be overlooked that in a large grove or plantation the shade afforded by the dense crowns of the trees takes the place of cultivation in keeping the grass down and lessening the evaporation of water from the soil.

More care is necessary in thinning a windbreak or a plantation with rows wide apart, but trees spaced closely in the rows, than in removing crowded material from a stand evenly spaced both ways. Trees planted in wide rows always have a chance to branch toward the opening between the rows, thereby relieving themselves of the crowding in the row, and when any tree is removed from the row there is crowding from only two sides to fill the crown space. Less crowding gives the poorer trees more of a chance, necessitating better judgment in removing from the crowded row inferior trees which in an entirely closed plantation would be killed out by natural means.

PRUNING.

Pruning is the removal of some portion of a living tree and its purpose may be—

(*a*) To dispose of dead or diseased material.

(*b*) To renew or stimulate growth.

(*c*) To modify the form of the tree.

This operation, which is essential to the best growth and development of a tree, never should be done carelessly.

If it is desired to produce a stem free from branches, the young tree should be pruned gradually and a very few of the lower limbs removed each year. In order to have a well-developed stem the crown must be sufficient to produce the material. The tendency of the average person is to prune either too much or not at all. On young trees the pruning may be carried too far up the stem, so that the tree becomes top-heavy and is deformed or broken off in the first storm.

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Pruning is practiced most often to modify the form of a tree, but in many cases it is necessary in order to induce production of merchantable material. Some species, like the boxelder or black locust, may sprout freely from the root collar, and unless the sprouts are removed promptly the new growth will pass into them and several small stems will develop rather than one large one. Such trees as the honey locust and white elm have a tendency to branch too near the ground. By removing the lower limbs a longer, straighter merchantable stem will be produced.

Carelessness in pruning is manifest usually in the rough knots and stubs left wherever the limbs are cut off. These scars and broken surfaces make a breeding ground for wood-rotting fungi; and through them decay may reach to the heart of the tree, causing it to die or break off, or may produce a cavity in the stem, making it almost worthless. Pruning always should be done with sharp tools to avoid a bruised surface, and as little of the limb should be left as possible. The cut should be even with the main stem. In removing large, heavy limbs there is always danger of the limb tearing the bark on the underside. This may be lessened by making two cuts in the branch, one on the underside of the limb near the tree and the other on the upper side 15 or 20 inches beyond the lower. When the limb has dropped the remaining stub may be cut close to the trunk. Water and fungus spores may be kept out of fresh wounds or cuts by applying common lead paint immediately.

Pruning may be done at any season of the year, if care is exercised; but the danger of separating the bark from the body is least if the pruning is done in fall or winter, when the tree is dormant and the sap is not flowing. About one-third of the top and branches of a hardwood should be cut back when the tree is set out.

PROTECTION.

Grazing animals never should be allowed to use the plantation as a pasture. The trees are damaged, reproduction either by seed or sprouts is made impossible, and the continued trampling tends to make the ground hard and dry, thus robbing the trees of the moisture which they always need.

Fire also is an enemy of the plantation, and unless the trees are otherwise guarded fire lines from 5 to 6 feet wide should be plowed around the area and kept free from grass and weeds as long as there is danger from this source.

Cropping the plantation is a fruitful source of loss. Crops should not be planted between the rows, unless it be small truck for one or two years. If the soil is so rich or moist as to permit the handling of crops between the rows, it would be better to plant more trees per acre.

Some loss is occasioned by rabbits and pocket gophers. Rabbits may be destroyed by poisoning with strychnine solution sprinkled upon alfalfa leaves and distributed along frequented runways or about feeding grounds. Care must be taken, however, to safeguard domestic animals from this poison. Pocket gophers may be poisoned by sprinkling a mixture of strychnine and saccharine upon cubes of sweet potatoes, carrots, or beets, which are then inserted into the underground runways. The Bureau of Biological Survey, Washington, D. C., has made extensive studies of methods of destroying rodent pests, and should be consulted to obtain specific instructions regarding their eradication.

Insects may cause serious damage, and where the attack is severe aid should be sought from the Bureau of Entomology, Washington, D. C., or from the experiment station maintained by the State, specimens of the insects or their work, or both, being forwarded whenever possible.

WHERE TO SECURE TREES AND SEED.

A list of dealers handling tree seed and nursery stock will be furnished free of charge upon application to the Forest Service, Department of Agriculture, Washington, D. C.

DON'TS FOR TREE PLANTERS.

Don't plant on ground poorly prepared.
Don't plant on raw, new, or soddy ground.
Don't buy a poor grade of stock. Consult several nurseries.
Don't plant late in the spring. Early work gives best results.
Don't allow plants to become dry.
Don't dig shallow holes. Loosen up the soil.
Don't dig small holes. Tree roots must not be cramped.
Don't put grassy sods in a hole. Air spaces will kill the tree.
Don't put manure in direct contact with tree roots.
Don't plant carelessly. You are working for the future.
Don't trim conifers when planting.
Don't plant hardwoods without cutting back one-third of the top.
Don't fail to cultivate thoroughly.
Don't let weeds grow. The trees need the moisture.
Don't rob the plantation by planting other crops in it.
Don't allow any stock within the plantation.
Don't expect a large grove in a year. Trees grow slowly.

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